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### Relative Abundance and Size Composition of Sablefish (Anoplopoma fimbria) in the Coastal Waters of California and Southern Oregon, 1984- 1988

by  
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August 1989

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## ABSTRACT

Survey results indicate that the relative abundance of sablefish (Anoplogoma fimbria) off California and southernmost Oregon increased by 130% in numbers and 87% in pounds per trap between 1986 and 1988. This increase was due to increased-abundance of small (3.0-4.25 lb) and under-size (<3.0 lb rd. wt.) sablefish. Catch rates increased at eight of nine sites sampled and were highest at the three southern sites.. The proportion of small and under-sized sablefish increased from 75% of the catch in 1986 to 90% of the catch in 1988. Highest catches-occurred at the depths of 225 and 300 fathoms.- Mean. length increased with depth, and relatively large fish,. though fewer. in numbers,. were taken in depths greater than 600 fathoms. Mean. length decreased from north to south within the sampling area.

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## INTRODUCTION

The sablefish (Anoplopoma fimbria) has been the single most valuable commercial groundfish species landed on the U.S. west coast since 1985, with the- estimated ex-vessel value averaging \$12.1 million- for 1985-88.<sup>1/</sup> High demand and attractive prices have resulted in heavy fishing. pressure on the stocks. Based on 1986 and 1987 survey results by the Northwest and Alaska Fisheries Center (NWAFC) and other supporting information, the Groundfish Management Team (GMT) declared in November 1987 that the west coast sablefish stock was biologically stressed and that the fishery could no longer support long-term landings of the magnitude observed. in recent years (13,000 to 18,000 metric--ton, t) (Groundfish Management Team 1987). In the 1988 assessment (Methot and Hightower 1988) the GMT determined that Maximum Sustainable Yield (MSY) was approximately 8,000 t and that the biomass in 1988 was above the biomass which yields MSY. The 1989 optimum yield (OY) was set at 10,400 t with a reserve of 600 t.

NWAFC surveys to measure changes in sablefish relative abundance began in southeastern Alaska waters in 1978, were extended to Oregon and Washington- waters in 1979, and to waters off California in 1980. Objectives of these surveys were to obtain catch per unit effort (CPUE) indices of sablefish abundance at standard index sites. Secondary objectives included collection of data on the state of maturity and determining weight, length, and age composition. Tagging was conducted to improve our understanding of movements and to identify potential management units. Beginning with the 1986 survey, double tagging was done to provide an estimate of tag loss. The results of the 1979-87 surveys in the Washington-California region have been reported by

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<sup>1/</sup>Pacific Coast Fisheries Information Network (PacFin) as of January 17, 1988. Pacific Marine Fisheries Commission, Metro Center - Suite 170, 2000 S.W. First Ave., Portland, Oregon **97201-5346**.

Parks and Hughes (1981), Parks (1982, 1984), and Parks and Shaw (1983, 1985, 1987, 1988a, 1988b). This report presents results of the 1988 survey off California and southernmost Oregon and compares them with results of previous surveys.

#### SURVEY METHODS AND GEAR

Methods used in earlier surveys and-trap gear employed through 1982 are described in detail by Parks and Shaw (1983); changes in methods and gear used in the- 1984 survey are described by Parks and Shaw (1985). The 1986 and 1988 survey methods were identical to the 1984 survey methods except that rectangular traps were eliminated and conical traps were used exclusively.

The conical traps employed in this study are constructed with a bottom ring 54 in (137 cm) outside diameter and a top ring 33.5 in (85 cm) outside diameter. The traps are 28 in (71 cm) high with a tunnel entrance on the side. The framework is covered with 2-1/4-in (5.7 cm) 42-thread nylon webbing. Tunnels are constructed of 2-in nylon knotless web and are rigged with a noose arrangement which is closed by a magnesium alloy timed released device 24 (+ 1) hours after setting. Ten traps are attached by gangions at 50 fathom (91 m) intervals on a 550 fathom groundline of 5/8-in (1.59 -cm) synthetic line. Trap bridles are attached to the gangions by C hooks. A perforated plastic bait jar containing approximately two pounds of chopped herring is hung in each trap.

Sampling was conducted during October and November 1988 from north to south at nine index sites off California and southern Oregon. These sites were also sampled in 1984 and 1986 (Fig. 1). A lo-trap groundline was fished as near as possible and parallel to the 225, 300, 375, 450, and 525 fathom isobaths

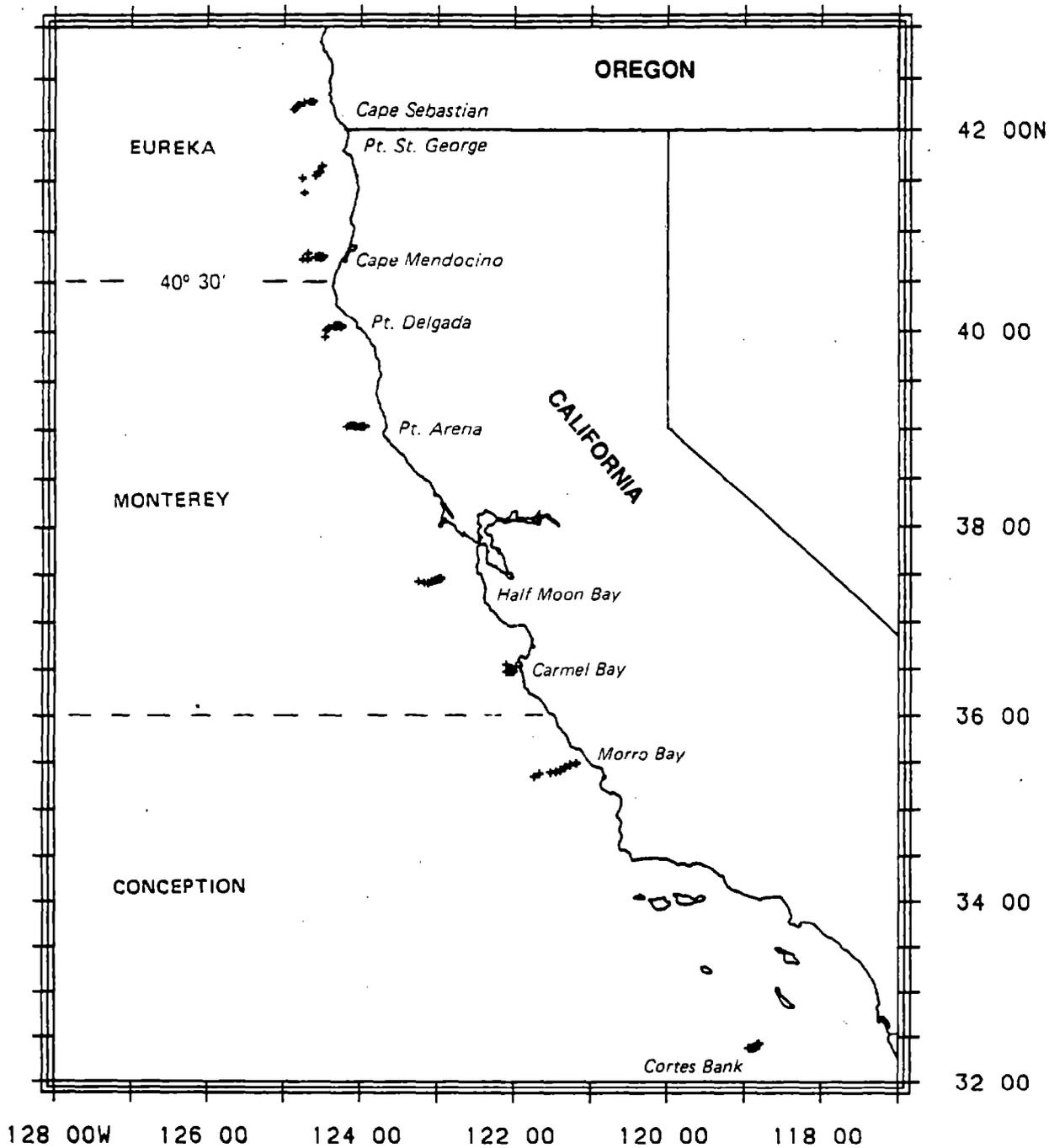


Figure 1 .--Sites sampled off California and southern Oregon (International North Pacific Fisheries Commission areas Eureka, Monterey, and Conception) during the 1988 sablefish abundance indexing survey.

at all sites. An additional string was set at 150 fathoms at all sites except Point St. George, and between 617 and 880 fathoms at the eight southern sites to examine the relative importance of depths outside the usually sampled depths. Two sets were made at each depth at most sites. Loran C and depth sounders were used to position replicate sets as near as possible to the locations of previous sets. If some traps on a string were lost, the observed catch for the string was adjusted by assigning the average catch in the remaining traps to lost traps. Occasionally, due to weather, gear conflict, or time constraints, the replicate set at a site could not be completed. In those cases, the catch in the replicate set (needed because the index is based on the average of both sets) was estimated by calculating the rate of decline in CPUE between the first and second sets at all other sites and depths and applying that rate to the catch from the single set (catch on the second set averaged  $0.703 \times$  catch on the first set).

Standard data collections included:

1. Number and weight of sablefish captured in each trap;
2. Number and weight of other species;
3. Length frequencies of all sablefish;
4. Otoliths, sex, and sexual maturity from a random sample of 20 sablefish captured at each depth at each site (each sablefish from which otoliths were taken was weighed to the nearest 5 grams using a high resolution triple beam balance);
5. All sablefish not required for the otolith samples were double tagged and released.

Because the primary objective was to establish the relative stock size for the entire survey area, individual site data (Appendix) are not discussed in detail.

## RESULTS

Replicate sampling was not conducted at the Cape Sebastian site, a second set was made only at 225 fathoms at the Point St. George site, and a replicate set was not made at 525 fathoms at the Half Moon Bay site. Adverse weather and mechanical problems prevented these repetitions from being made, and catch rates were adjusted as described in the methods.

## Catch Rates and Size Composition

Catch rates (average number of fish per trap), based on data from standard depths (225-525 fathoms) at the nine abundance index sites, increased 130% from 1986 to 1988. The 1988 catch rate of 10.6 fish per trap also represents an increase of 8% from the 9.8 fish per trap in 1984 (Fig. 2). Most of the increase is in numbers of small fish taken mainly in the shallower sets. Catch rates of small (<4.25 lb) sablefish increased from an average of 3.4 fish per trap in 1986 to 9.6 per trap in 1988. Catch rates of medium-size (4.25 to 7.0 lb) sablefish remained unchanged at 1.0 fish per trap, and the catch rates of large (>7.0 lb) sablefish declined from 0.2 fish per trap in 1986 to fewer than 0.1 in 1988. Catch rates shown for 1980-82, although not directly comparable with those of 1984-88 because the two original stations had to be changed as a result of gear conflicts (Parks and Shaw 1985), exhibit similar trends to catch rates of sablefish from surveys off Oregon and Washington in 1979-82 (Parks 1984). Catch rates in 1988 were up at all sites except Cape Sebastian with largest increases occurring from Point Arena south (Appendix Fig. 1). The three southern sites had the highest catch rates of 15.5 to 18.8 fish per trap, as compared to 4.7 to 8.1 fish per trap at the four northern sites. Average catch rates in weight of sablefish (lb per trap) from the standard depths increased 87% from 17.6 lb to 32.9 lb between

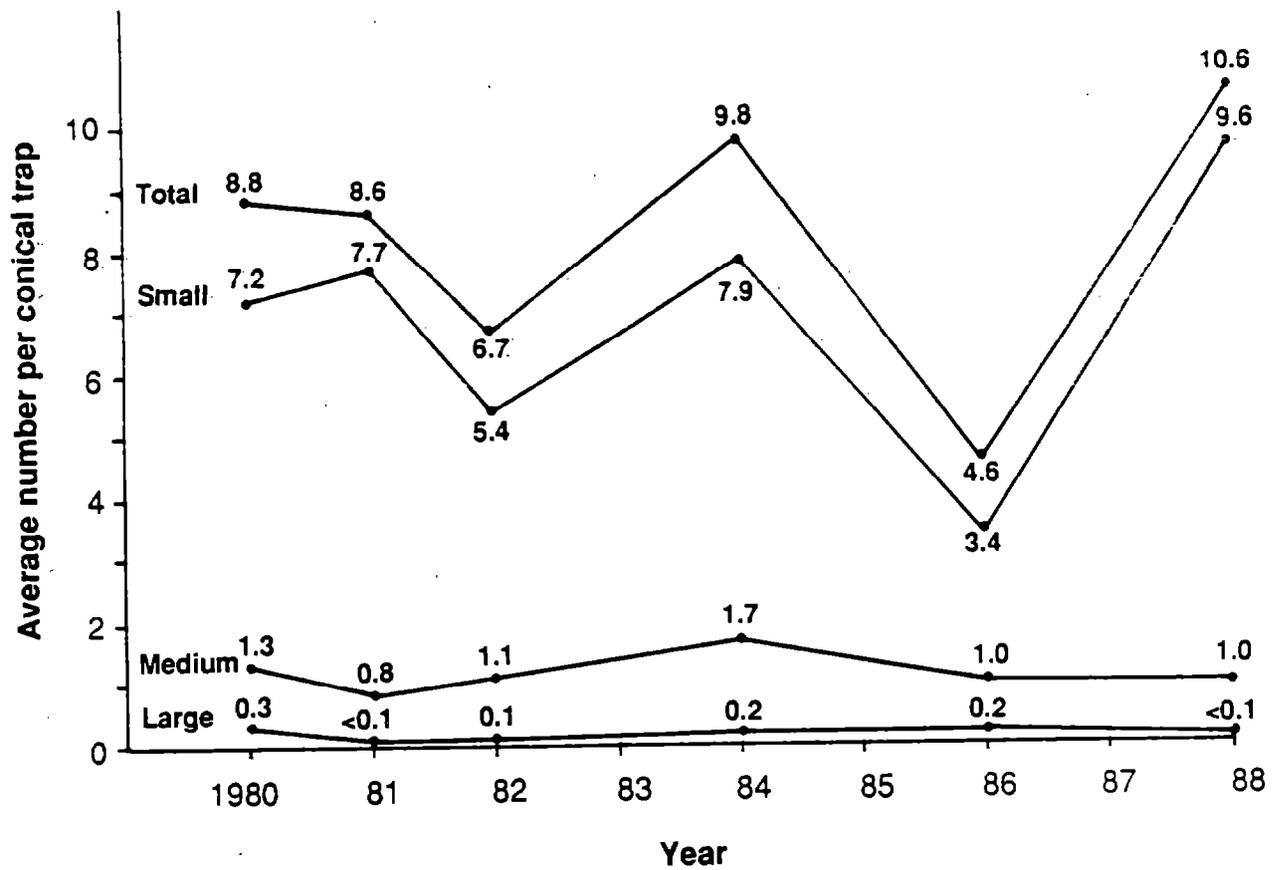


Figure 2.--Mean catch rates of sablefish by size category in standard depths (225-525 fathoms) at two index sites off California in 1980-82 and nine index sites fished off California and southern Oregon in 1984, 1986, and 1988. No surveys were conducted in this area in 1983, 1985, and 1987.

1986 and 1988 (Fig. 3). The 1988 value was down slightly from the 34.6 lb per trap taken in 1984.

Highest catches (number/trap) within the standard sampling depths (225-525 fathoms) occurred at 225 and 300 fathoms (Table 1). Catch rates at 150, 375, 450, and 525 fathoms were similar and were lowest at depths more than 600 fathoms (Table 1). Catches averaged 3.8 sablefish per trap from 600 to 700 fathoms, 2.7 fish per trap from 700 to 800 fathoms, and 1.5 fish per trap from 800 to 900 fathoms.

Size composition for 1984, 1986, and 1988 are compared in Figure 4. Mean length, after increasing slightly from 53.1 to 53.7 cm between 1984 and 1986, decreased sharply to 50.8 cm in 1988, reflecting a much higher proportion of smaller fish at the standard depths. The proportion of small and undersized sablefish (<4.25 lb) increased from 75% of the catch in 1986 to 90% in 1988, whereas the proportion of medium (4.25 to 7.0 lb) and large (>7.0 lb) sablefish decreased from 21 to 9% and from 4 to less than 1%, respectively (Table 1). The increases in numbers of small fish can be clearly seen in Figure 4. Over two thirds (67%) of our catch in 1988 consisted of undersized sablefish<sup>2/</sup>, up sharply from 49% in the 1986 survey (Fig. 4).

The sex specific size composition for sablefish taken at the standard depths during the 1988 survey is shown in Figure 5. The mean sizes of males and females were 51.0 cm and 54.9 cm, respectively.<sup>3/</sup> Using our 1986 calculations for length at 50% maturity (51.9 cm for males and 57.9 cm for females, Parks and Shaw 1988a) and our 1988 random samples, we calculate that

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<sup>2/</sup> Less than 52 cm fork length = less than 3.0 lb round weight.

<sup>3/</sup> The mean size of all captured sablefish (50.8 cm) is less than the mean size of males and females because the small sablefish tended to occur in larger than average catches so that they are underrepresented in the fixed size random samples.

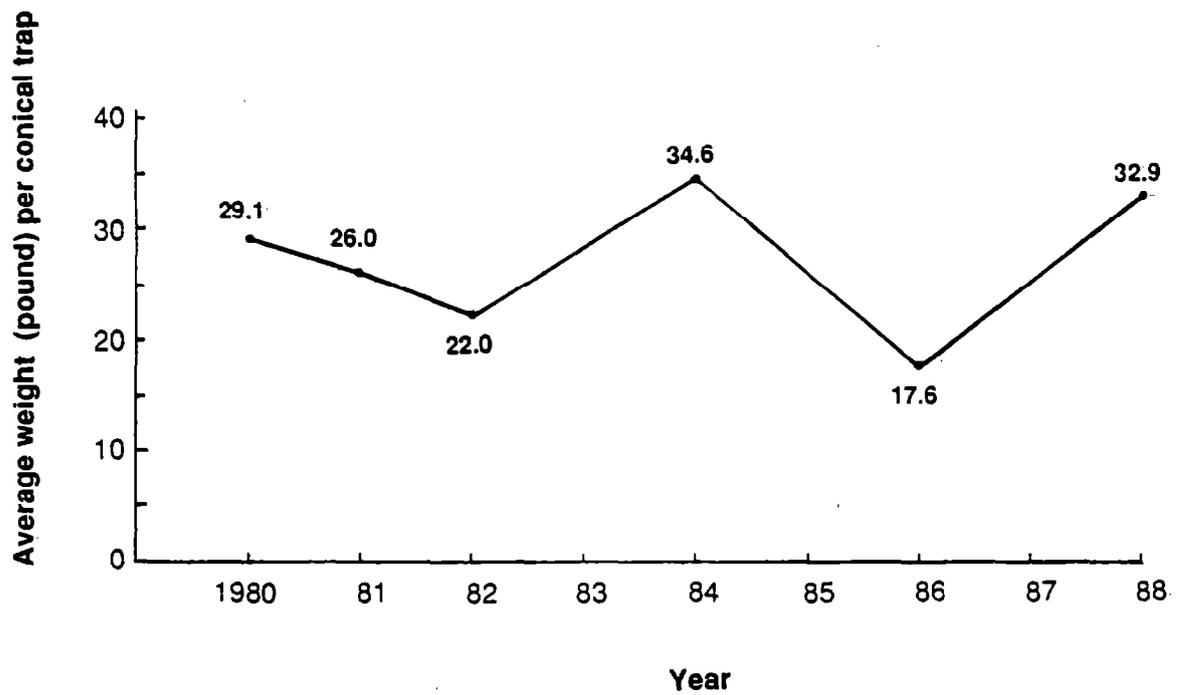


Figure 3. --Mean catch rates of sablefish in lb. per trap at the two original index sites off California 1980-82, and at nine sites off California and southernmost Oregon 1984, 1986, and 1988, (standard depths 225-525 fathoms).

Table 1.--The numbers of sablefish, average numbers and weight by trap, and percentage of sablefish by size<sup>a</sup> captured at southernmost Oregon and California by depth in 1984<sup>b</sup>, 1986, and 1988.

Depth (fm)	Year	Total no. sablefish	Avg. no. sablefish per trap	Avg. wt. (lb) per trap	% Large sablefish	% Medium sablefish	% Small sablefish	% Undersized sablefish
150 <sup>d</sup>	1984	420	5.2	16.1	1	11	26	62
	1986	286 <sup>c</sup>	2.4	6.8	3	9	21	67
	1988	1,014 <sup>c</sup>	6.3	16.9	<1	5	17	77
225	1984	2,736	15.2	51.0	2	16	32	50
	1986	1,262 <sup>c</sup>	7.0	23.4	2	18	25	55
	1988	4,136 <sup>c</sup>	23.0	62.9	<1	5	16	79
300	1984	2,571	14.3	48.9	2	14	32	52
	1986	1,105 <sup>c</sup>	6.1	23.2	4	20	31	45
	1988	2,382 <sup>c</sup>	13.2	39.2	<1	7	18	74
375	1984	1,499	8.3	28.5	3	16	36	45
	1986	689	3.8	16.3	7	20	37	36
	1988	1,053 <sup>c</sup>	5.8	18.6	<1	9	24	66
450	1984	1,263 <sup>c</sup>	7.0	25.6	2	17	41	40
	1986	595 <sup>c</sup>	3.3	13.0	3	19	38	40
	1988	932 <sup>c</sup>	5.2	18.1	2	14	29	55
525	1984	757	4.2	18.8	5	34	44	17
	1986	479	2.7	12.0	4	33	45	18
	1988	1,075 <sup>c</sup>	6.0	25.3	2	28	42	27
> 600 <sup>e</sup>	1986	189	2.4	18.5	47	49	4	0
	1988	502 <sup>c</sup>	3.1	21.7	33	54	11	2
All depths combined	1984	9,246 <sup>c</sup>	9.4	33.1	2	17	35	46
	1986	4,605 <sup>c</sup>	4.2	16.5	6	21	31	42
	1988	11,094 <sup>c</sup>	9.1	29.3	2	10	21	67
Standard depths combined	1984	8,826 <sup>c</sup>	9.8 <sup>f</sup>	34.6	2	17	35	46
	1986	4,130 <sup>c</sup>	4.6 <sup>f</sup>	17.6	4	21	33	42
	1988	9,579 <sup>c</sup>	10.6 <sup>f</sup>	32.9	<1	9	22	68

<sup>a</sup>Large = over 7.0 lb round weight (rd. wt.); medium = 4.25-7.0 lb rd. wt.; small = 3.0-4.25 lb rd. wt.; and undersized = less than 3.0 lb rd. wt.

<sup>b</sup>The 1984 numbers are the result of upward adjustment on rectangular trap catches by 1.265 (a scaling factor to compensate for the lesser fishing efficiency of the rectangular traps) plus conical trap catches.

<sup>c</sup>Adjusted upward for missing string(s) of gear, second repetitions not made, or lost traps, based on the average decline of catch from the first set to the second set.

<sup>d</sup>150 fathom depth fished at the four southern sites only in 1984, at the three northern and three southern sites only in 1986, and at eight sites in 1988.

<sup>e</sup>>600 fathom depth not fished in 1984, fished at the four northern sites only in 1986, and fished at the eight southern sites in 1988.

<sup>f</sup>Standard error = 0.750 for 1984, 0.345 for 1986, and 1.16 for 1988.

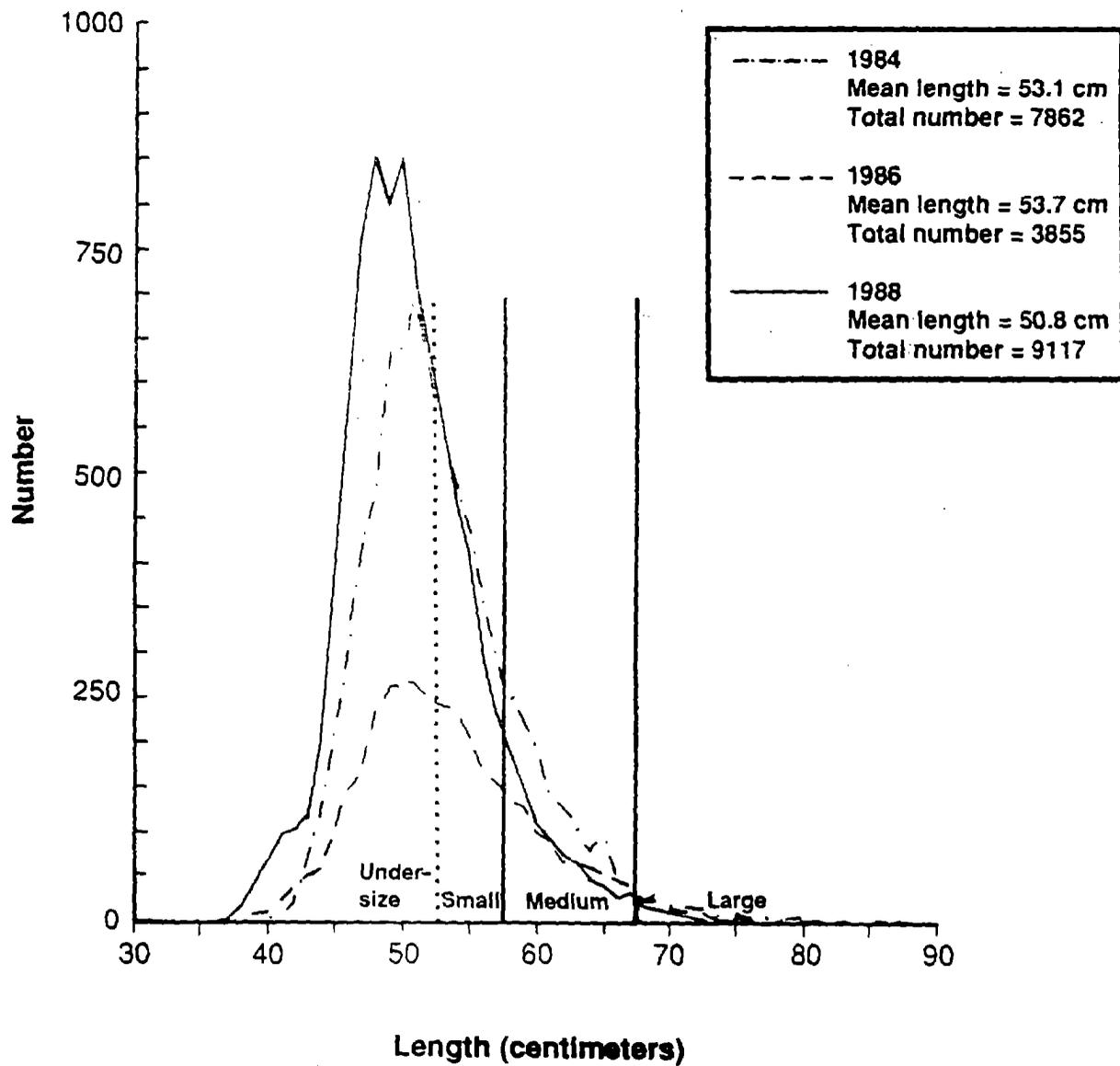


Figure 4.--Sablefish length compositions for all southern Oregon and California index sites combined at standard depths (225-525 fathoms) for 1984, 1986, and 1988.

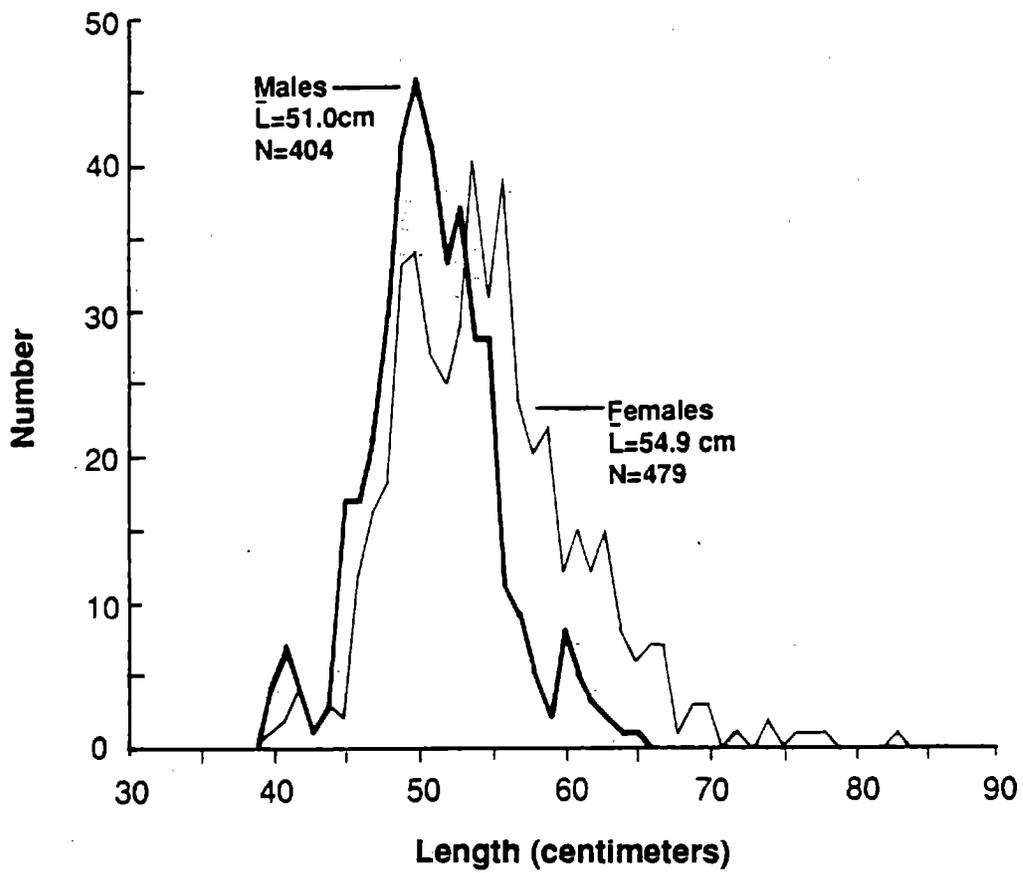


Figure 5.--Sablefish length compositions by sex of random samples taken from standard depths (225-525 fathoms) during the 1988 abundance index survey.

within the standard depths (225-525 fathoms), 57% of the males and 71% of the females are immature.

#### Mean Length by Depth and by Latitude

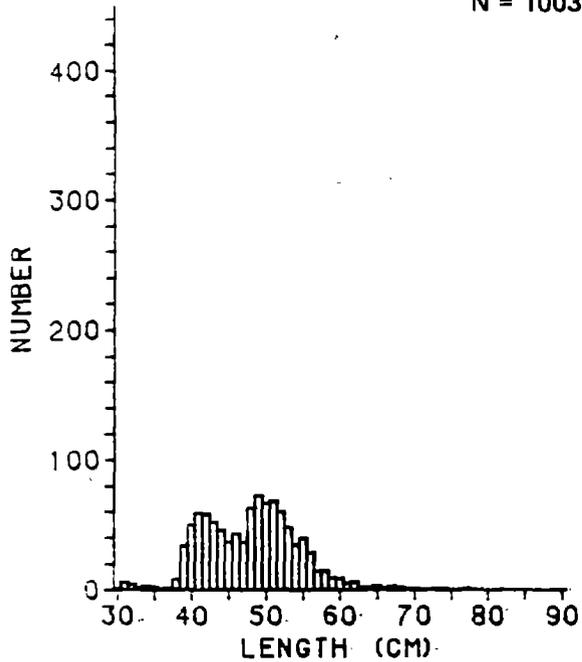
Length compositions by depth for the 1988 survey are shown in Figure 6. Mean lengths typically increase with depth, and 1988 was no exception. The largest increases occurred between 450 and 525 fathoms, where mean lengths increased approximately 3 cm, and between 525 and greater than 600 fathoms, where mean lengths increased approximately 9 cm (Fig. 7). The mean lengths of sablefish captured at depths greater than 600 fathoms averaged about 17 cm greater than that of sablefish captured at 150 fathoms. At depths of 600-700, 700-800, and 800-900 fathoms, mean lengths were similar at 64-65 cm (6.8 to 7.0 lb round weight). Mean lengths of sablefish at all depths fished in 1988 were smaller than those observed in the 1984 and 1986 surveys.

Sablefish mean length generally decreased from north to south during all three survey years (Fig. 8). Length compositions by site for the 1988 survey are shown in Appendix Figure 2. Mean lengths were smaller at all but one of the sites in 1988 than in previous surveys. A regression line calculated **for** all three survey years shows that mean length decreased by 2.6 cm between the Cape Sebastian and Cortes Rank sites (Fig. 8). The trend of the decreasing mean length from north to south appears in looking at the entire west coast (including Oregon and Washington surveys in 1985 and 1987) (Fig. 9). Regression lines calculated for each group for 1984-88 survey years show that mean lengths of male, female, and total sablefish (including unsexed) decreased 2.7, 4.5, and 2.6 cm, respectively, between northern Washington and southern California sites.

CALIF &amp; S. OREGON - 150 FM - 1988

MEAN LENGTH = 48.1 TOTAL

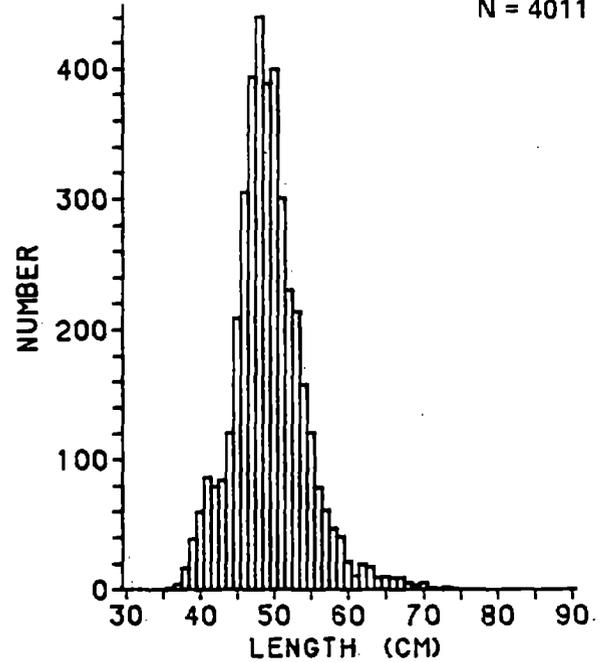
N = 1003



CALIF &amp; S. OREGON - 225 FM - 1988

MEAN LENGTH = 49.3 TOTAL

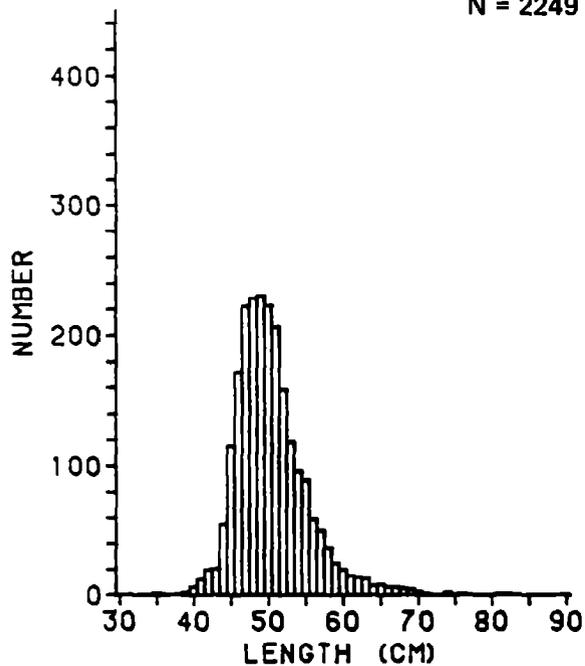
N = 4011



CALIF &amp; S. OREGON - 300 FM - 1988

MEAN LENGTH = 50.4 TOTAL

N = 2249



CALIF &amp; S. OREGON - 375 FM - 1988

MEAN LENGTH = 51.3 TOTAL

N = 971

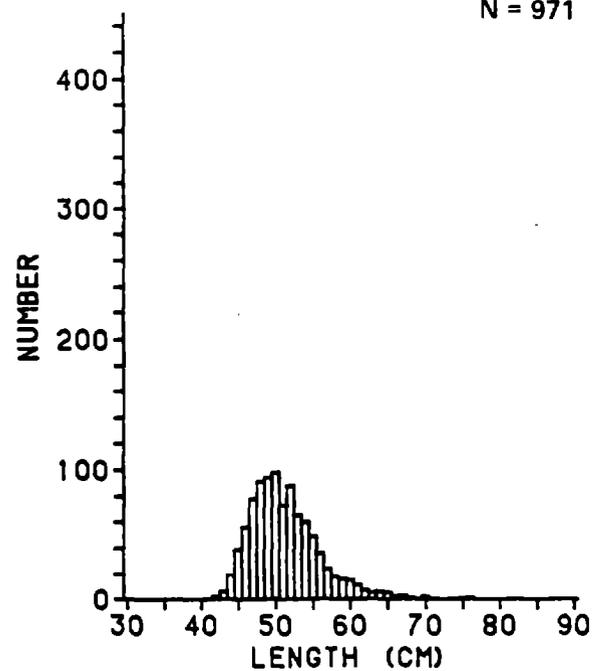
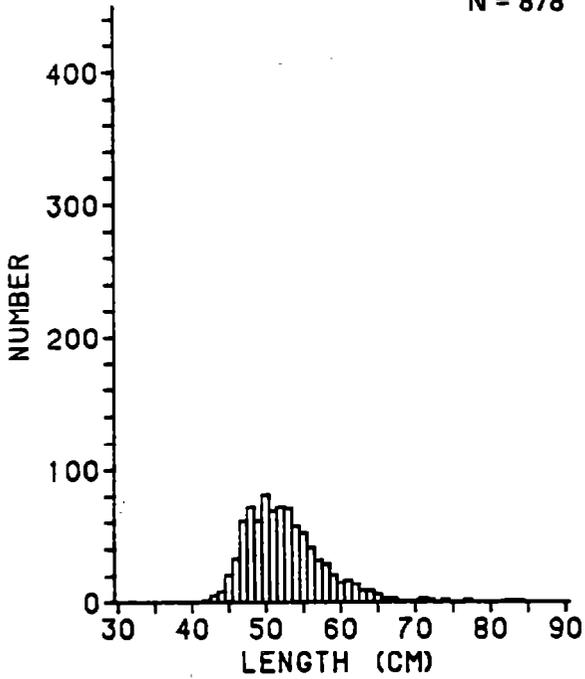


Figure 6.--Sablefish length compositions by depth for all sites combined during the 1988 abundance index survey (150 fathoms fished at all sites except Point St. George and >600 fathoms fished at all sites except Cape Sebastian).

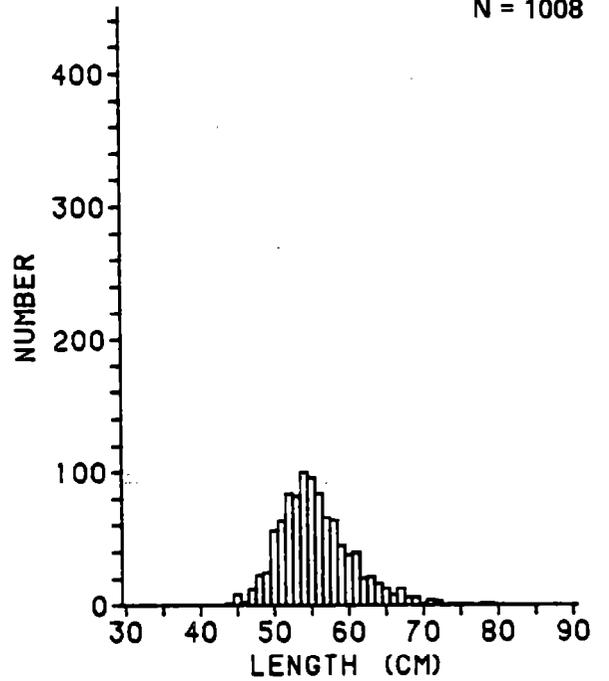
CALIF & S. OREGON - 450 FM - 1988

MEAN LENGTH = 52.7    TOTAL  
N = 878



CALIF & S. OREGON - 525 FM - 1988

MEAN LENGTH = 55.7    TOTAL  
N = 1008



CALIF & S. OREGON - >600 FM - 1988

MEAN LENGTH = 64.8    TOTAL  
N = 350

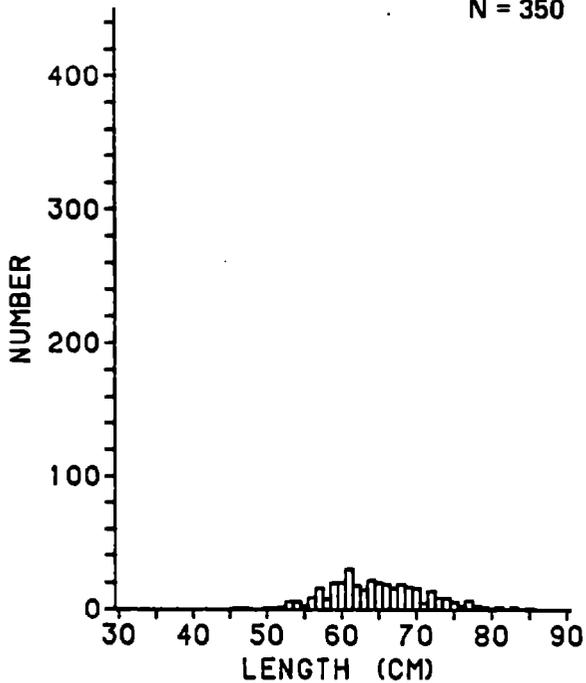


Figure 6. --Continued.

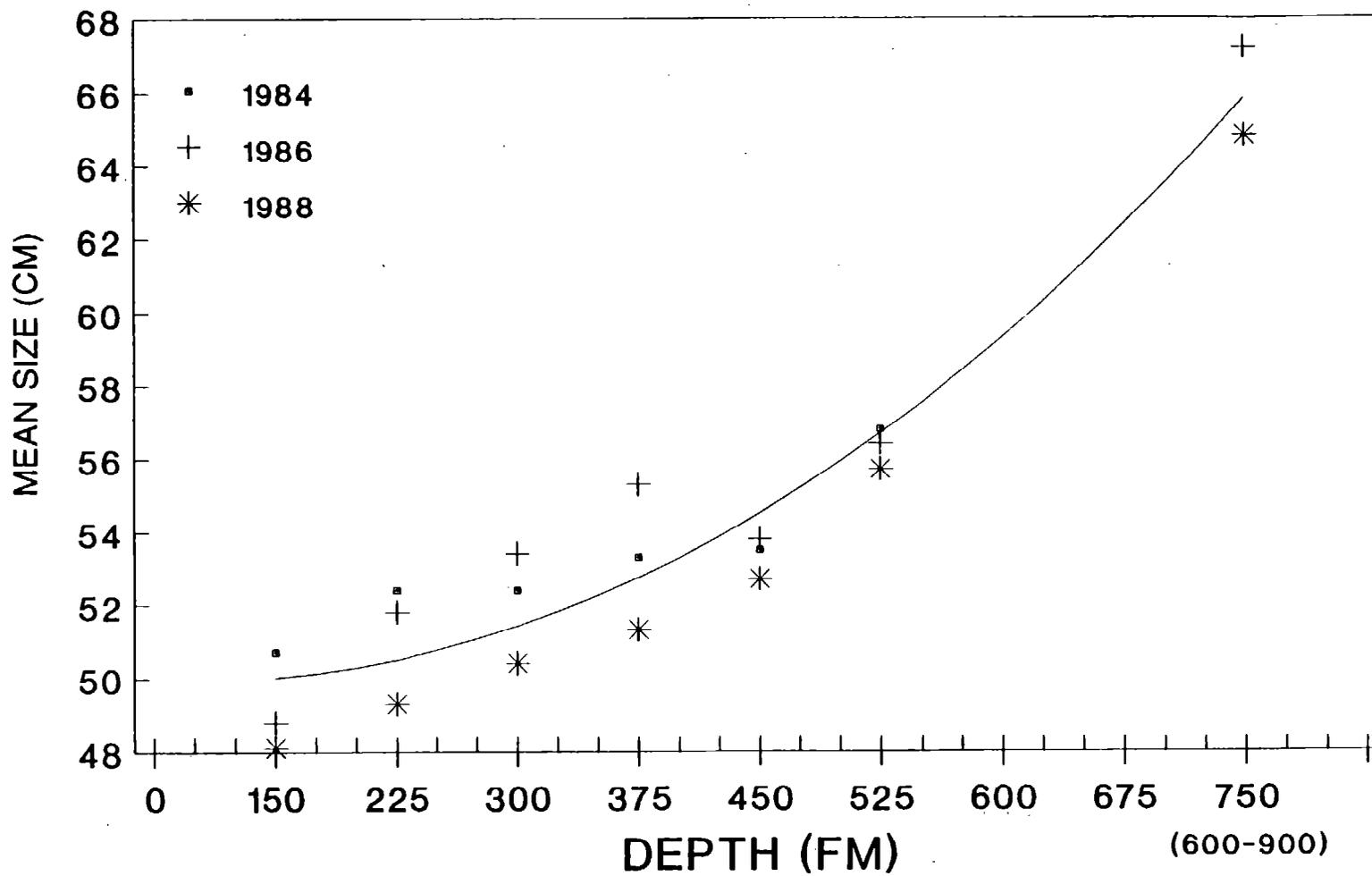


Figure 7. --Mean fork length by depth from southern Oregon and California abundance index surveys in 1984, 1986, and 1988. The curve is the quadratic regression line.

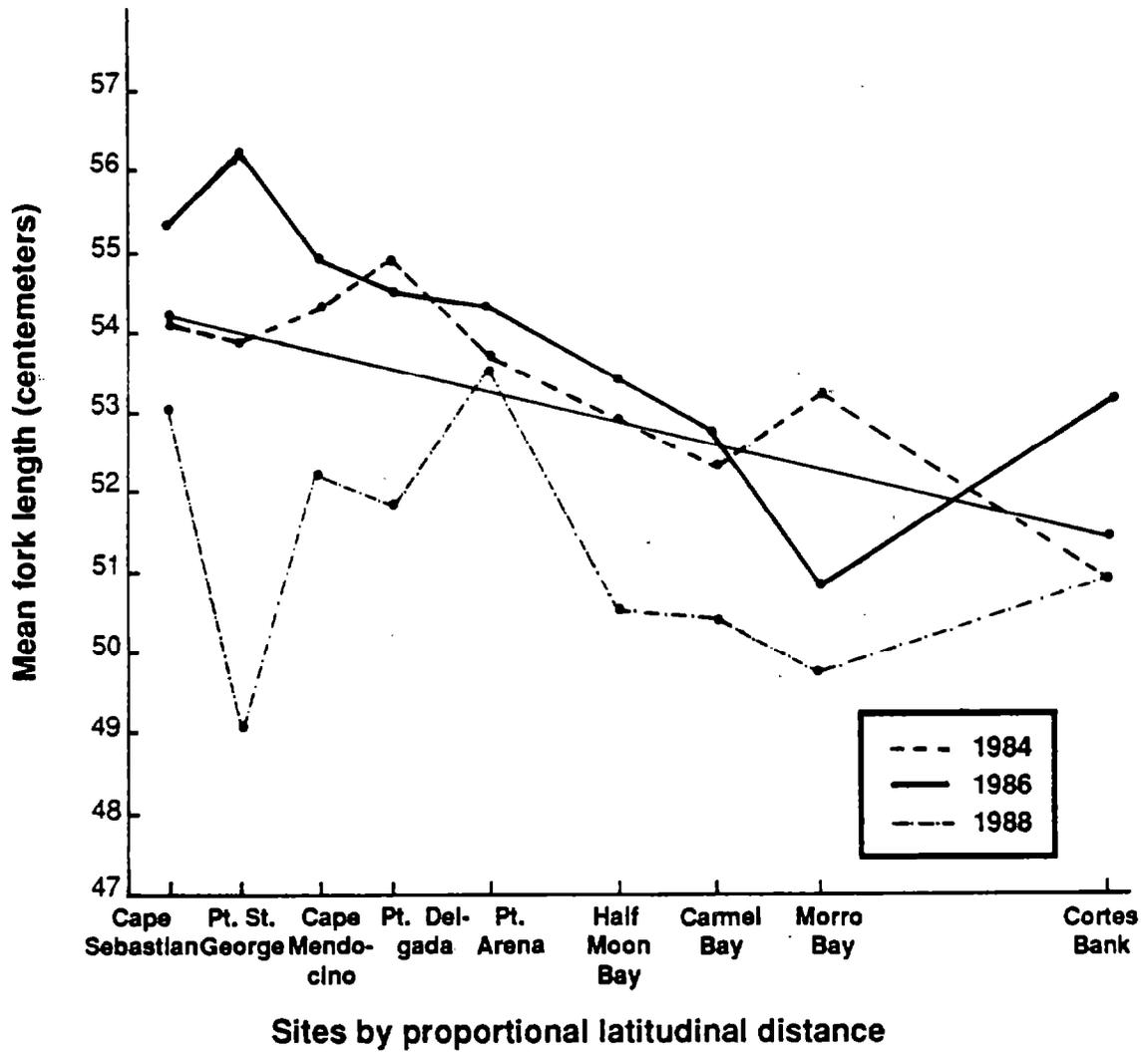


Figure 8.--Mean fork length by site from southern Oregon and California abundance index surveys in 1984, 1986, and 1988 (standard depths 225-525 fathoms). The straight line is a least squares regression line.

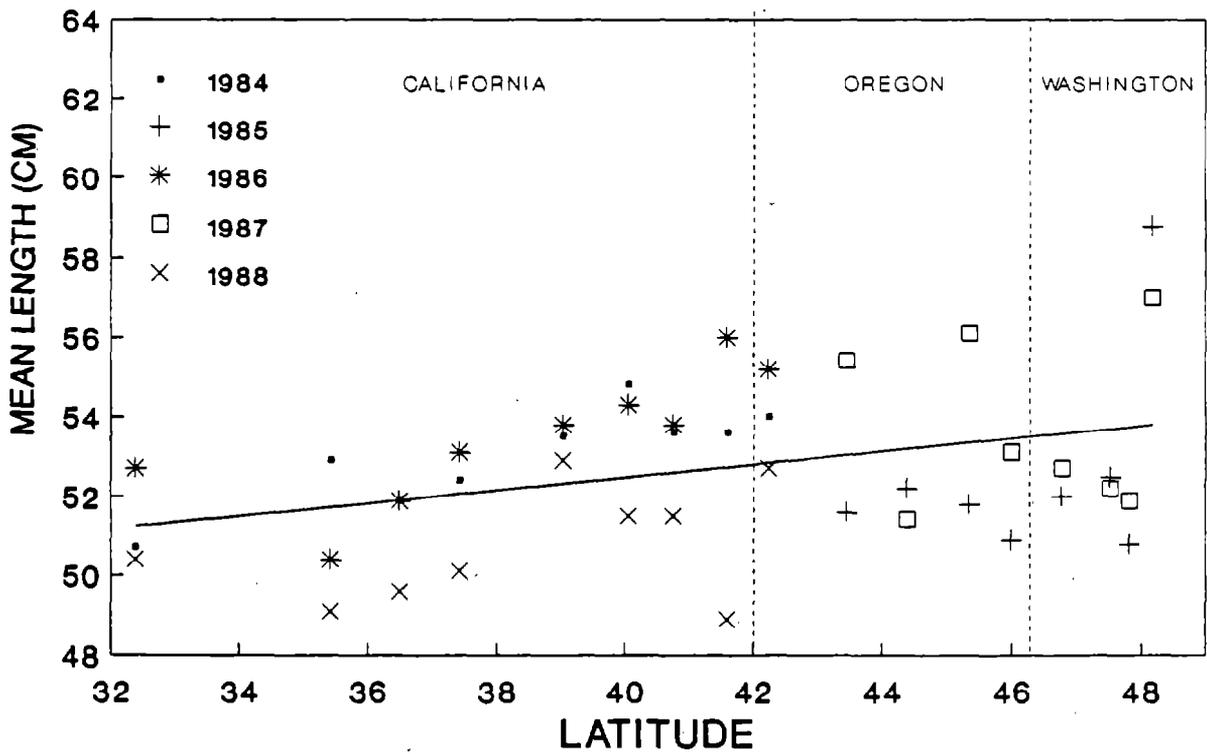
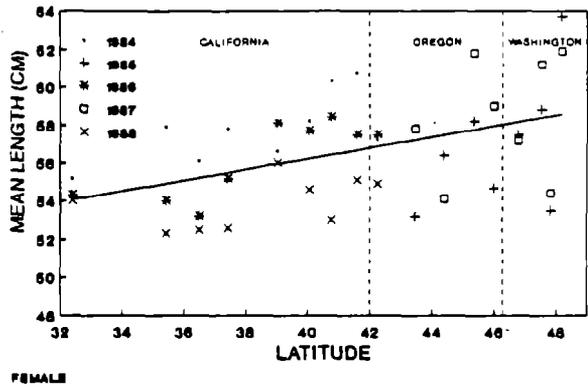
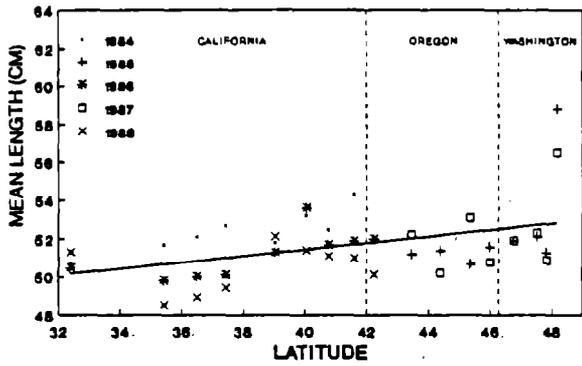


Figure 9.--Mean fork lengths of sablefish off California, Oregon, and Washington taken at depths of 225-450 fathoms during abundance index surveys, 1984-88.

## Length-Weight Relationships

The length-weight relationships for male and female sablefish are shown separately in Figure 10. Parks and Shaw (1988a, 1988b) found no significant difference in average weight at length between males and females for surveys conducted off Oregon and Washington (August and September 1987) or off southern Oregon and California (September to mid-November, 1986). The 1988 length-weight relationship for males is  $W = .0036267 \times L^{3.251361}$ , for females is  $w = .0019122 \times L^{3.42254}$ , and for sexes combined is  $W = .0022443 \times L^{3.373018}$ , where  $W$  = weight in grams-and  $L$  = length in centimeters (Fig. 10). The 1988 length-weight relationships for males and females were significantly different at the 99.9% level. Predicted male weights were greater at lengths up to 53 cm but female predicted weights were 0.5, 2, and 3% greater than those of males at lengths of 55, 60, and 65 cm, respectively. Since the 1988 survey was conducted approximately 2 weeks later in the year than the 1986 survey, and thus closer to the winter spawning season, females may have added more egg mass than was observed in the 1986 survey when the length-weight relationship was identical for both sexes. For sexes combined, the 1986 and 1988 length-weight relationships were nearly identical. Comparing the 1988 combined length-weight relationship with that calculated for Oregon and Washington sablefish in 1987, the 1987 fish were heavier up to lengths of 55 cm (approximately the length at 50% maturity for sexes combined determined by Parks and Shaw 1988a), whereas the 1988 sablefish were heavier at greater lengths, ranging from 1% heavier at 60 cm to 7% heavier at 80 cm. Again, this difference is probably due to the fact that the 1988 survey was conducted later in the year (nearly 2 months in this case) and much closer to the spawning season.

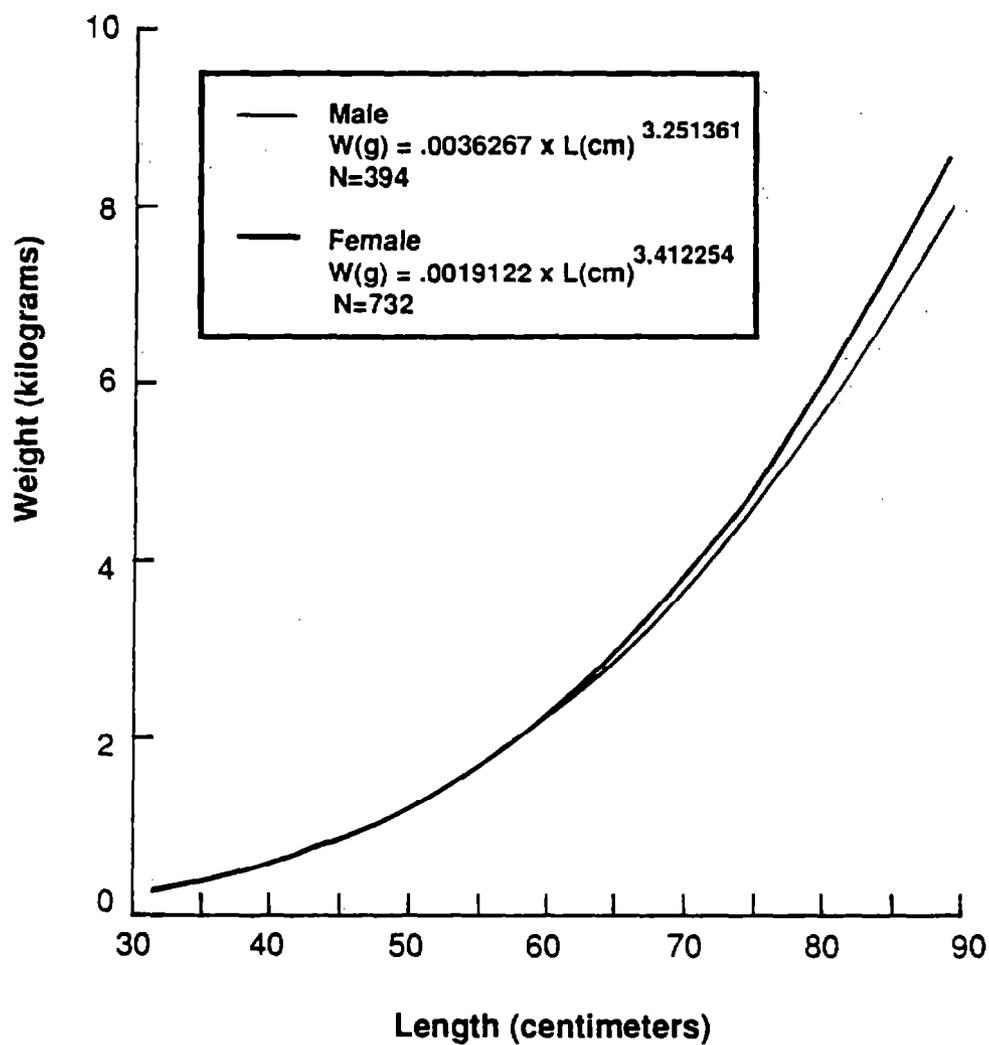


Figure 10.--Length-weight relationships derived from sablefish collected off southern Oregon and California in October and November 1988.

## SUMMARY and CONCLUSIONS

Sablefish catch rates (mean number per trap) in surveys off California and southern Oregon increased by 130% between 1986 and 1988. This increase was due entirely to larger numbers of small and undersized (<4.25 lb) sablefish. Catch rates of medium-size (4.25-7.0 lb) sablefish were unchanged and catch rates of large-size (> 7.0 lb) sablefish declined by about 46% in numbers (86 in 1988 vs. 160 in 1986). Catch rates increased at all sites except Cape Sebastian, with the largest increases occurring at Point Arena, California and southward. The three southern sites had the highest catch rates and the lowest catch rates were at the four northern sites (Appendix Fig. 1 and Appendix Table 1).

The increased catch rate of undersized sablefish from 1986 to 1988 caused the mean length to decrease (Fig. 4 and Table 1). Over 68% of our catch in 1988 consisted of undersized (<3.0 lb) sablefish, up sharply from 42% in the 1986 survey. The proportion of small (3.0 to 4.25 lb) sablefish decreased from 33% of the catch in 1986 to 22% in 1988, while the proportion of medium and large fish decreased from 21 to 9% and from 4% to <1%, respectively (Table 1). The mean length of males was 51.0 cm, whereas the mean length of females was 54.9 cm (Fig. 5). Mean lengths were smaller at all depths and sites sampled in 1988 than they were in 1984 or 1986 (Figs. 7 and 8). Sablefish mean lengths tended to decrease from north to south during all three survey years (Fig. 8).

While 1988 results indicate good recruitment of 2+- and 3+-year-old (40-50 cm) sablefish, especially from Point Arena south, we are concerned that numbers of medium and large sablefish are declining and now account for only 10% of the catch. The mean lengths for both sexes are below our calculated lengths at 50% maturity (51.9 cm for males and 57.9 cm for females) (Parks and

Shaw 1988a). We estimate that only about one-third of the population surveyed in 1988 is sexually mature. To obtain an estimate of the percentage of immature sablefish landed by the fishery, we reviewed the size frequency of sablefish landings by trawl, longline, and trap in 1987 (Methot and Hightower 1988) and determined the numbers landed at sizes smaller than the size at 50% maturity. The percentage of sablefish harvested at sizes below 50% maturity by gear type in 1987 were longline, males 25%, females 30%; pot, males 11%, females 46%; trawl, males 58%, females 82%. These values do not include the discards of small and undersize fish, which if included would make the percentages even higher, especially for the trawl gear, which is known to select for small fish (Klein 1986). Large numbers of sablefish are being harvested before they have an opportunity to spawn.

The loss of large, high fecundity females and mature males from the population has uncertain biological implications. McFarlane and Beamish (1986) have hypothesized that such loss could result in more variable and reduced recruitment because the presence of substantial numbers of high fecundity individuals may serve to buffer the effects of unfavorable environmental conditions during and just after spawning. A more certain economic implication is that fishermen must spend **more** time sorting their catches and discarding undersized sablefish in order to meet size limit regulations and they must expend more effort to land larger, more valuable sablefish.

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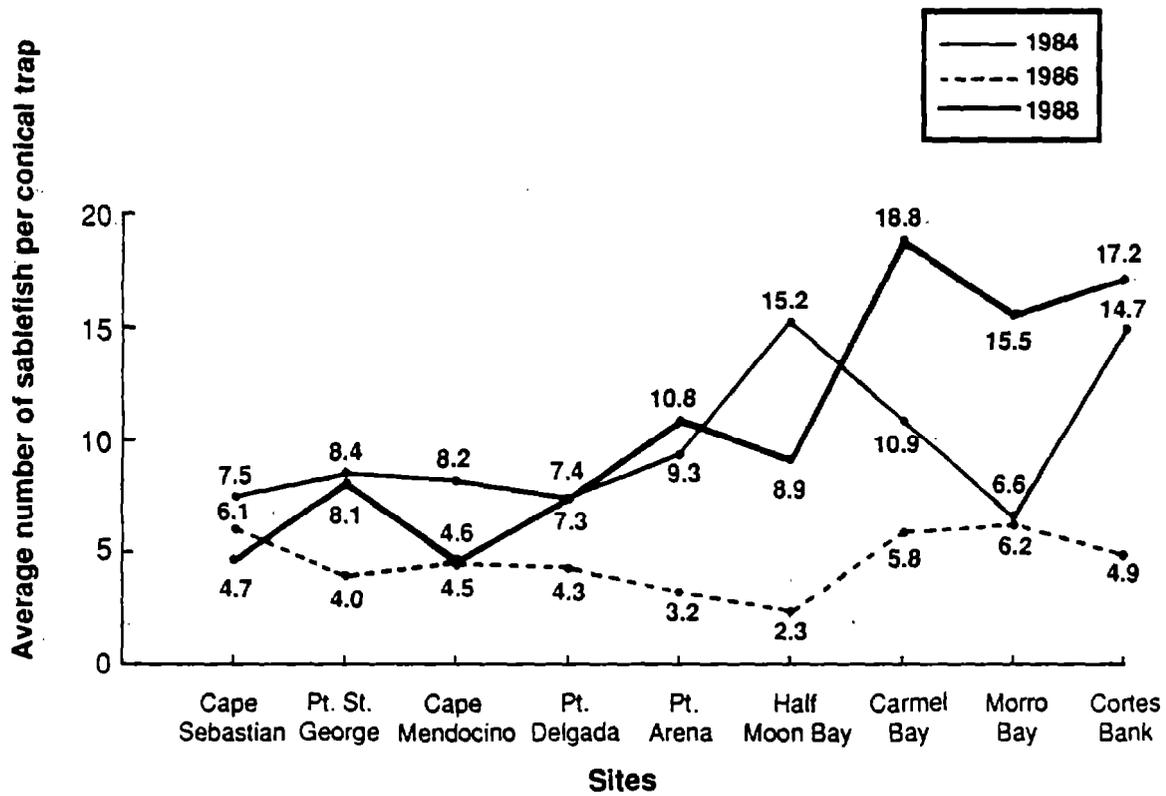
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APPENDIX

Individual Index. Site Data

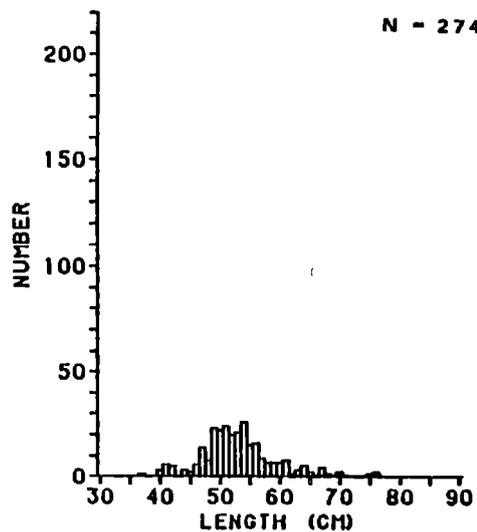


Appendix Figure 1.--Mean catch rates at nine index sites fished off California and southern Oregon in 1984, 1986, and 1988 (standard depths 225-525 fathoms).

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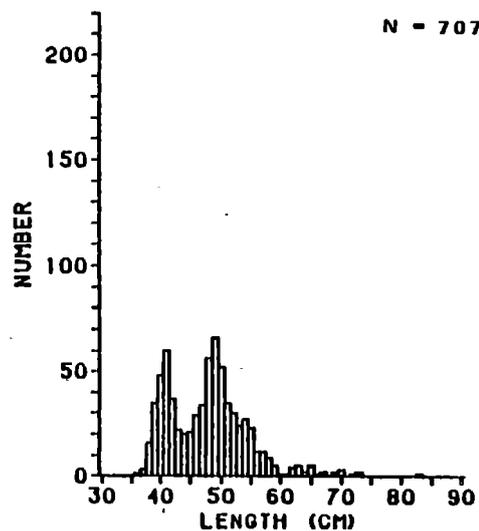
CAPE SEBASTIAN, OR - 1988  
MEAN LENGTH = 53.0 TOTAL

N = 274



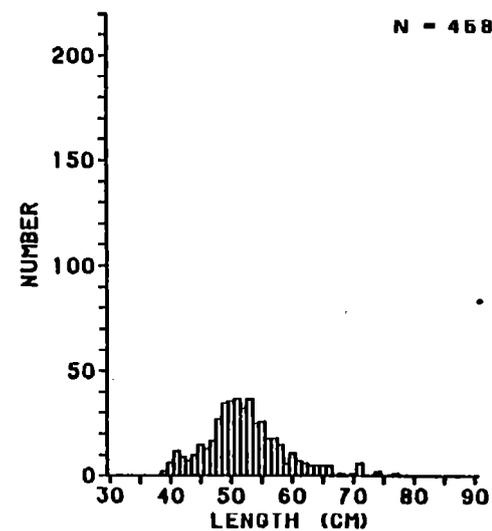
POINT ST. GEORGE, CA - 1988  
MEAN LENGTH = 47.8 TOTAL

N = 707



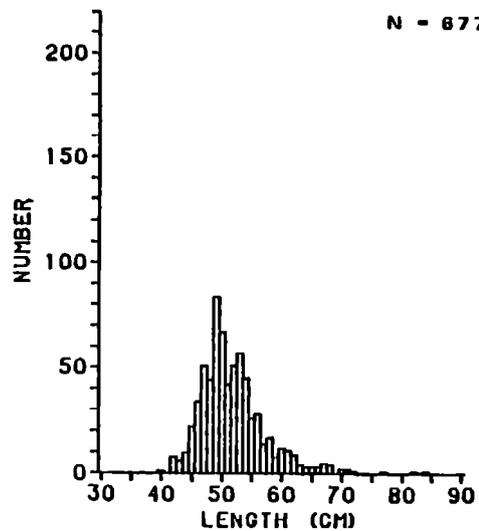
CAPE MENDOCINO, CA - 1988  
MEAN LENGTH = 52.2 TOTAL

N = 468



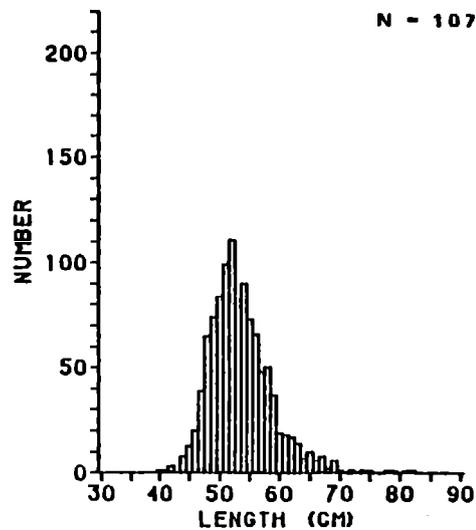
POINT DELOADA, CA - 1988  
MEAN LENGTH = 51.8 TOTAL

N = 877



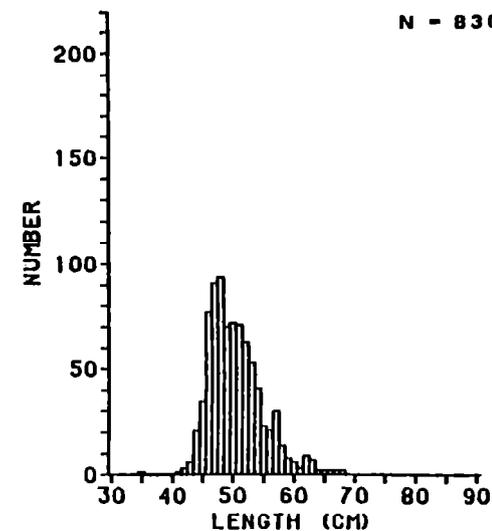
POINT ARENA, CA - 1988  
MEAN LENGTH = 53.5 TOTAL

N = 1079



HALF MOON BAY, CA - 1988  
MEAN LENGTH = 50.8 TOTAL

N = 830

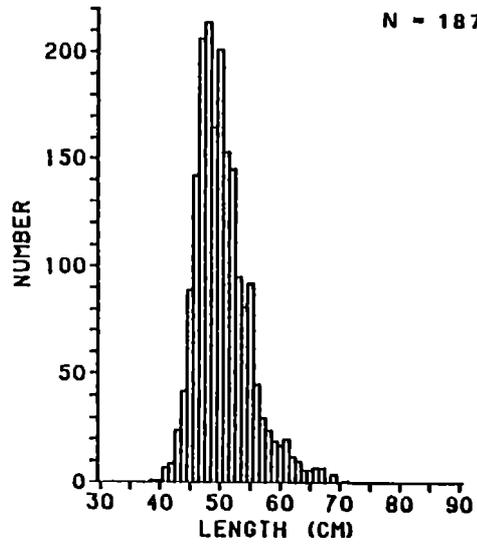


Appendix Figure 2. --Sablefish length compositions by abundance indexing site at the standard depths (225-525 fathoms) during the 1988 abundance indexing survey.

CARMEL BAY, CA - 1988

MEAN LENGTH = 50.4    TOTAL

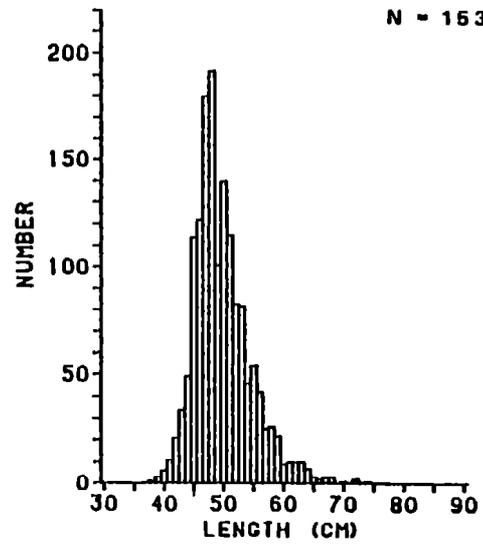
N = 1875



MORRO BAY, CA - 1988

MEAN LENGTH = 49.8    TOTAL

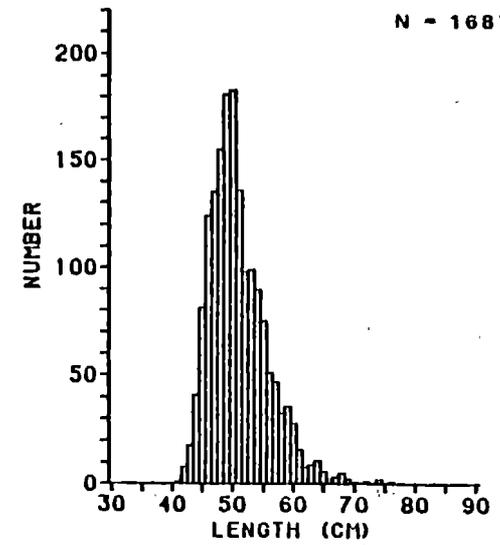
N = 1530



CORTES BANK, CA - 1988

MEAN LENGTH = 50.9    TOTAL

N = 1687



Appendix Figure 2.--Continued.

Appendix Table 1.--Sablefish catch rates and percentage by size category from southern Oregon and California index sites in 1984<sup>a</sup>, 1986 and 1988 (standard depths 225-525 fathoms).

Site	Year	Total no. sablefish	Avg. no. sablefish per trap	Avg. wt. (lb) per trap	% Large <sup>b</sup> sablefish	% Medium <sup>c</sup> sablefish	% Small <sup>d</sup> sablefish	% Under-sized <sup>e</sup> sablefish
Cape Sebastian, OR	1984	748 <sup>f</sup>	7.5	31.5	7	19	25	49
	1986	613	6.1	25.8	9	21	32	38
	1988	472 <sup>f</sup>	4.7	17.3	2	16	32	50
Pt. St. George, CA	1984	843	8.4	31.7	3	22	34	41
	1986	405 <sup>f</sup>	4.0	16.7	7	28	35	30
	1988	807 <sup>f</sup>	8.1	21.3	2	6	17	75
Cape Mendocino, CA	1984	819	8.2	32.8	5	23	30	42
	1986	448 <sup>f</sup>	4.5	18.0	5	29	31	35
	1988	458	4.6	15.3	3	14	27	56
Pt. Delgada, CA	1984	735	7.4	29.1	4	23	39	34
	1986	427 <sup>f</sup>	4.3	18.2	5	26	32	37
	1988	726 <sup>f</sup>	7.3	23.2	2	11	25	62
Pt. Arena, CA	1984	928	9.3	33.9	1	20	41	38
	1986	325	3.2	13.3	4	25	33	39
	1988	1,079	10.8	38.7	2	17	33	48
Half Moon Bay, CA	1984	1,525	15.2	51.5	<1	15	40	44
	1986	226	2.3	8.6	1	20	38	41
	1988	892 <sup>f</sup>	8.9	26.5	<1	7	20	73
Carmel Bay, CA	1984	1,094	10.9	36.7	<1	14	31	51
	1986	580	5.8	20.7	1	17	36	46
	1988	1,875	18.8	54.7	<1	7	18	75
Morro Bay, CA	1984	664	6.6	24.5	2	17	37	44
	1986	619	6.2	20.0	<1	13	27	59
	1988	1,546 <sup>f</sup>	15.5	46.2	<1	7	16	77
Cortes Bank, CA	1984	1,470	14.7	44.0	<1	10	30	59
	1986	487	4.9	17.0	1	19	36	44
	1988	1,724 <sup>f</sup>	17.2	51.9	<1	9	22	69
All sites combined	1984	8,826 <sup>f</sup>	9.8	35.1	2	17	35	46
	1986	4,130 <sup>f</sup>	4.6	17.5	4	21	33	42
	1988	9,579 <sup>f</sup>	10.6	32.8	<1	9	22	68

<sup>a</sup> These numbers are the result of upward adjustment on rectangular trap catches by 1.265 plus conical trap catches.

<sup>b</sup> Over 7.0 lb round weight.

<sup>c</sup> 4.25-7.0 lb round weight.

<sup>d</sup> 3.00-4.25 lb round weight.

<sup>e</sup> Less than 3.00 lb round weight.

<sup>f</sup> Adjusted upward for missing string(s) of gear, second repetition which was not made, or individual traps which were lost, based on the average decline of catch from the first set to the second set.

Appendix Table 2.--Sablefish catch rates and percentage above the minimum size limit<sup>a</sup> by index site during the 1988 abundance index survey.

Depth (fm)	Cape Sebastian, OR				Pt. St. George, CA				Cape Mendocino, CA			
	No. of fish	No. per trap	Wt. per trap (lb)	% above size limit	No. of fish	No. per trap	Wt. per trap (lb)	% above size limit	No. of fish	No. per trap	Wt. per trap (lb)	% above size limit
150	0 <sup>b</sup>	0	0	0	--	--	--	--	87	4.4	6.5	1
225	68 <sup>b</sup>	3.4	9.0	40	565	28.2	67.5	15	142	7.1	21.3	30
300	175 <sup>b</sup>	8.8	29.9	46	150 <sup>b</sup>	7.5	21.1	18	111	5.6	15.6	28
375	131 <sup>b</sup>	6.6	26.3	62	36 <sup>b</sup>	1.8	6.2	52	87	4.4	13.6	40
450	61 <sup>b</sup>	3.0	9.8	31	41 <sup>b</sup>	2.0	8.8	83	64	3.2	14.1	75
525	37 <sup>b</sup>	1.8	8.5	73	15 <sup>b</sup>	0.8	2.9	89	54	2.7	12.1	82
617-880	--	--	--	--	70 <sup>b</sup>	3.5	19.4	98	44	2.2	16.3	100
All Depths	472	3.9	14.4	50	877	7.3	21.0	24	589	4.2	14.2	42
	Pt. Delgada, CA				Pt. Arena, CA				Half Moon Bay, CA			
150	50	2.5	7.9	32	118	5.9	12.3	17	160	8.0	20.4	12
225	308	15.4	46.2	30	525	26.2	81.7	38	279	14.0	41.0	27
300	198	9.9	29.3	33	210	10.5	42.0	61	219	11.0	29.4	13
375	128	6.4	19.5	36	71	3.6	11.7	38	128	6.4	17.5	22
450	53	2.6	12.3	70	75	3.8	14.0	60	172	8.6	26.3	34
525	39	2.0	8.8	80	198	9.9	43.9	80	94 <sup>b</sup>	4.7	18.4	73
617-880	97 <sup>b</sup>	4.8	40.6	100	102 <sup>b</sup>	5.1	34.7	98	85 <sup>b</sup>	4.2	28.3	100
All Depths	873	6.2	23.5	42	1,299	9.3	34.4	51	1,137	8.1	25.9	28

Appendix Table 2--Continued.

Depth (fm)	No.	No.	Wt.	%	No.	No.	Wt.	%	No.	No.	Wt.	%
	of fish	per trap	per trap (lb.)	above size limit	of fish	per trap	per trap (lb.)	above size limit	of fish	per trap	per trap (lb.)	above size limit
	<u>Carmel Bay, CA</u>				<u>Morro Bay, CA</u>				<u>Cortes Bank, CA</u>			
150	74	3.7	9.6	9	76	3.8	6.2	0	449	22.4	72.5	38
225	569	28.4	72.4	13	752	37.6	99.0	11	928	46.4	124.4	22
300	678	33.9	92.9	19	262	13.1	37.1	13	380	19.0	55.3	27
375	226	11.3	31.2	18	83	4.2	13.7	35	163	8.2	27.8	40
450	159	8.0	25.6	30	233	11.6	38.5	39	74	3.7	13.8	55
525	243	12.2	51.6	76	216	10.8	42.8	60	179	9.0	38.4	71
617-880	39	2.0	13.6	97	42	2.1	14.1	93	23	1.2	7.0	100
All depths	1,988	14.2	42.4	26	1,663	11.9	35.9	24	2,196	15.7	48.4	33
	<u>All sites combined</u>											
150	1,014 <sup>c</sup>	6.3	16.9	23								
225	4,136	23.0	62.9	21								
300	2,382	13.2	39.2	26								
375	1,053	5.8	18.6	34								
450	932	5.2	18.1	45								
525	1,075	6.0	25.3	73								
617-880	502 <sup>d</sup>	3.1	21.7	98								
All depths	11,094	9.1	29.3	33								

<sup>a</sup> Regulation set by the Pacific Fishery Management Council and includes sablefish smaller than 22 inches total length (52.4 cm fork length) or 15.5 inches dorsal length (origin of dorsal fin to the tip of the tail if beheaded).

<sup>b</sup> Adjusted upward for second set not made.

<sup>c</sup> 150 fathom depth fished at eight sites.

<sup>d</sup> 617-880 fathom depth fished at eight sites.